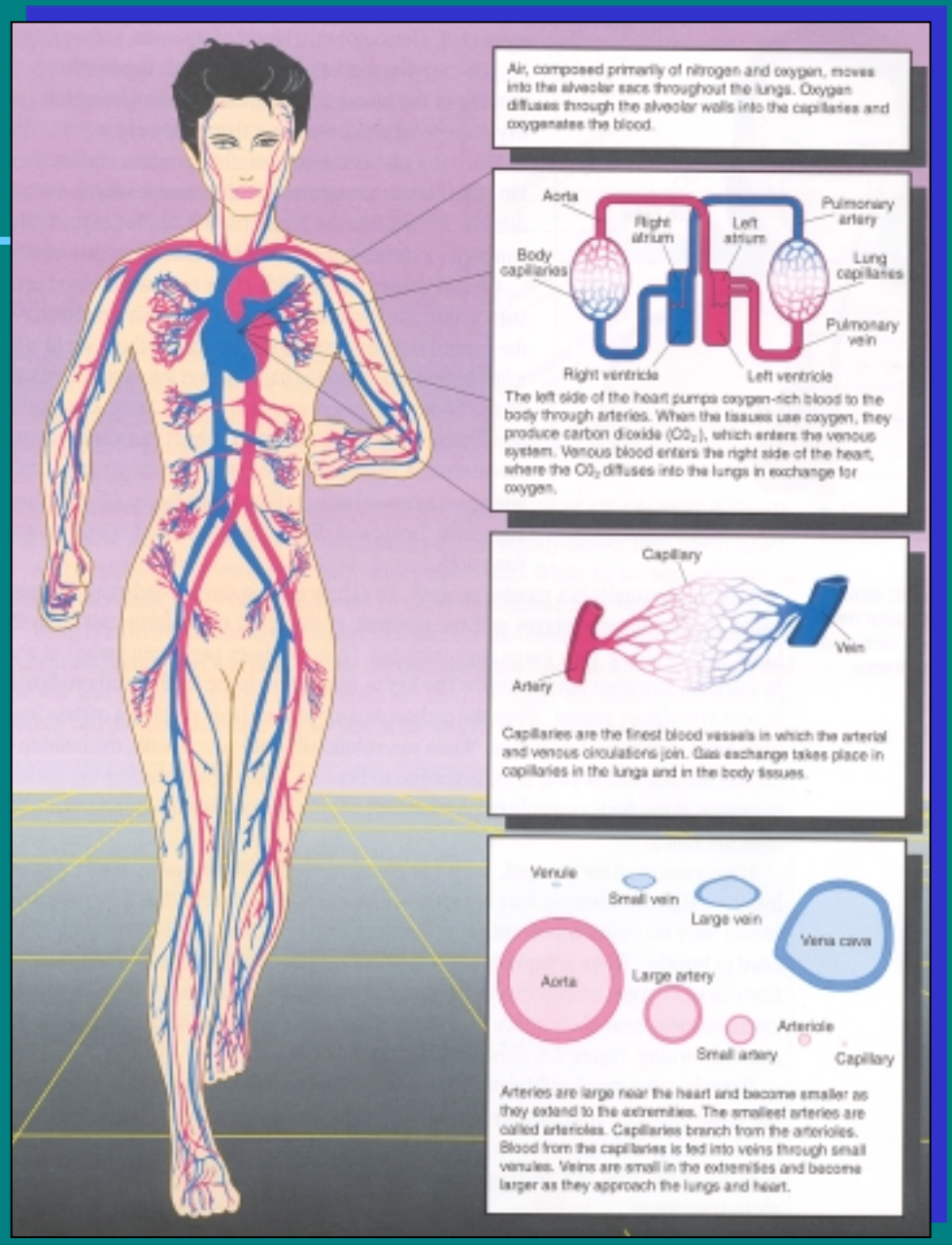
Circulation and Respiration

Presented by the NOAA Diving Center
Seattle, Washington

Global View

- Circulatory system
- Circulatory problems
- Respiratory system
- Respiratory problems

- Components:
  - Heart
  - Arteries
  - Arterioles
  - Capillaries
  - Venules
  - Veins
  - Lungs
  - Circulation route



Circulatory Problems

- Definition, causes, signs & symptoms, first aid, and prevention of:
  - Carotid sinus syndrome
  - Patent foramen ovale
  - Dehydration

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- Definition: Los
  stimulation
- Cause: Exces
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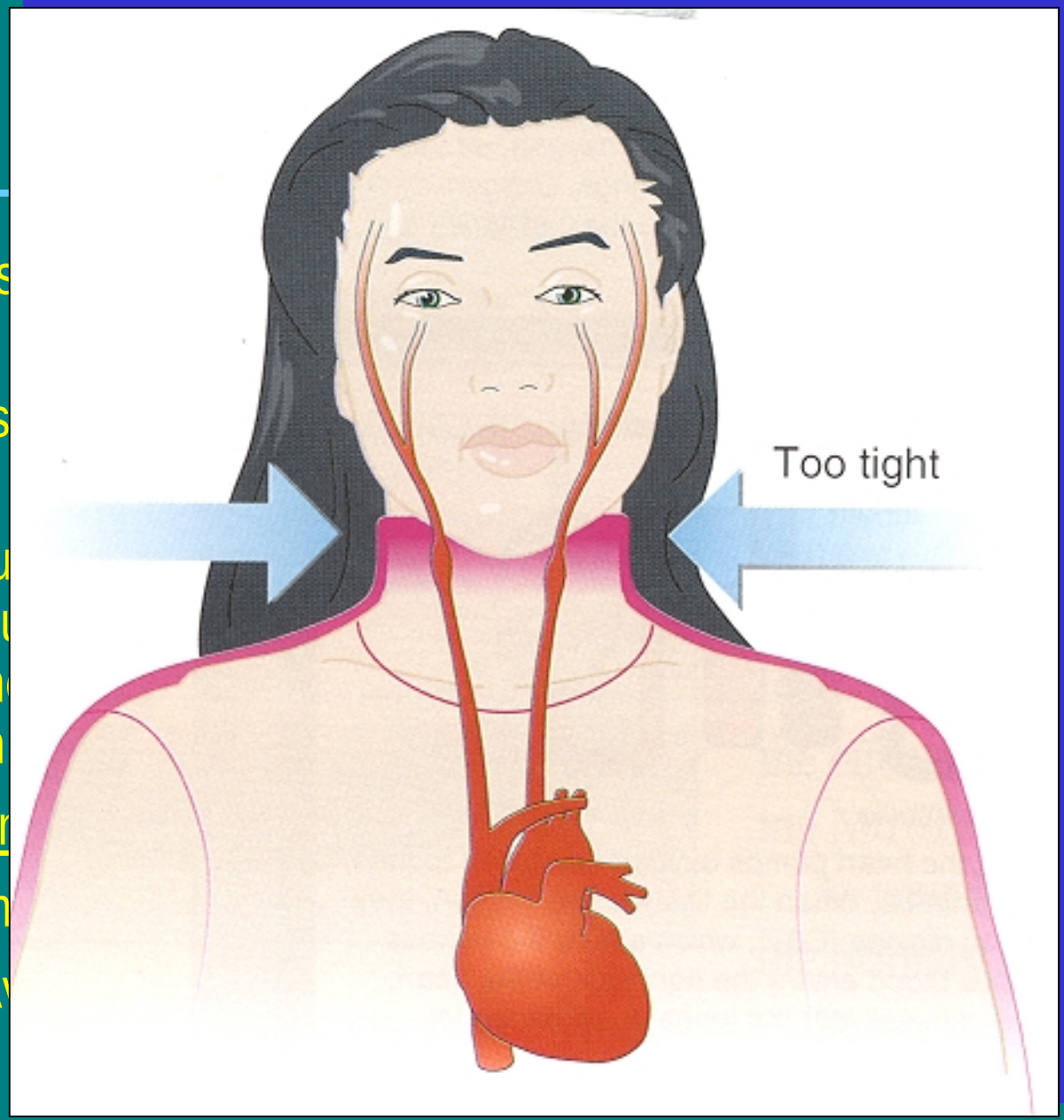
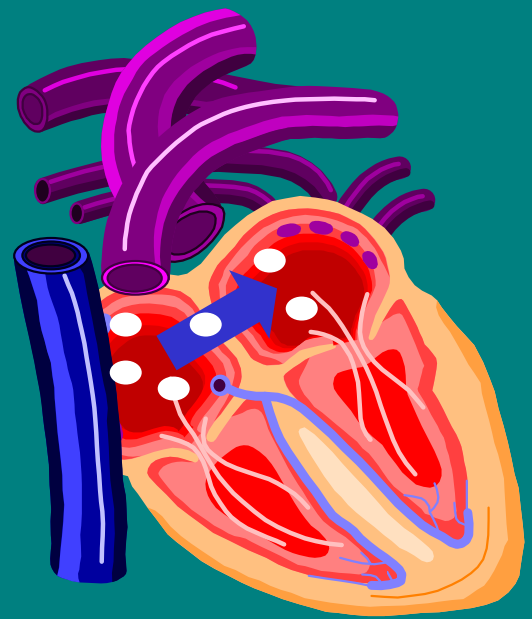
- Effect: Pressu
  heart and redu
  Lightheadedn
  upon exertion
- Signs and Syr
- First aid: Rem
- Prevention: A



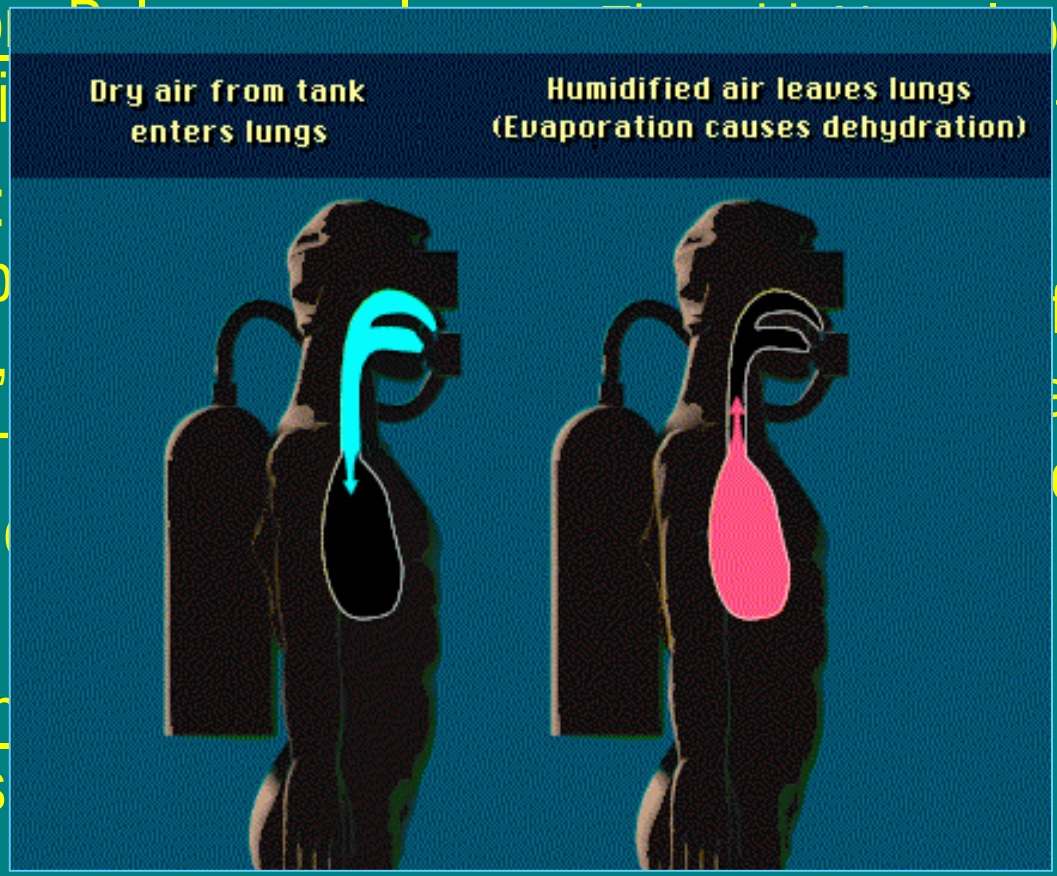
Patent Foramen Ovale

- Definition: Hole in the septum between heart chambers
- Cause: Birth defect
- Effect: Bubbles from venous circulation shunt to arterial circulation and cause decompression sickness (DCS)
- Signs and symptoms: Those of DCS, especially when undeserved
- First aid: See Decompression Sickness
- Prevention: Do not dive if you have PFO



Dehydration

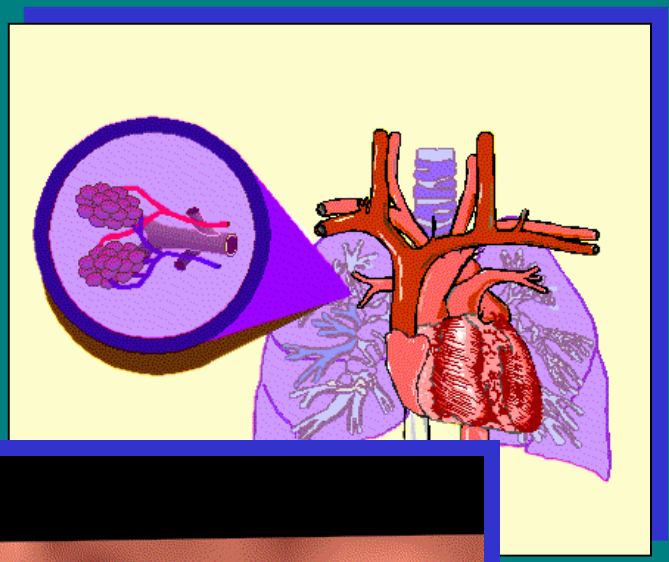
- Definitio holic, non-
  body flui treat for
- Causes:
  intake, b fluids
  diuresis, en dives,
- Effect: T erature
  which in
  DCS
- Signs ar
  Dryness
  shock

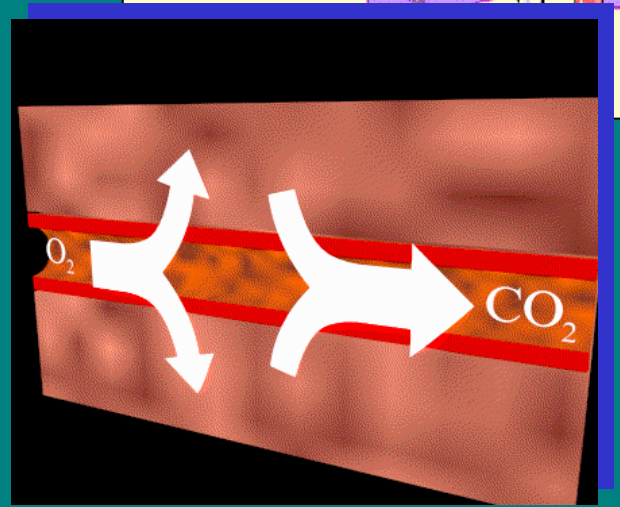


Respiration Basics

- Fresh air inspired into lungs (negative pressure)
- Oxygen diffuses into blood
- Blood carries O_2 to cells
- CO_2 is metabolism waste
- Blood carries CO_2 to lungs
- Used air expired from lungs (positive pressure)

What regulates breathing?





Physiology of Respiration-1

- Central Nervous System (CNS) senses CO_2 and O_2 levels in the blood
- Respiratory center of brain stimulates breathing
- Buildup of CO_2 forces you to breathe
- Normal resting respiratory rate is 12-16 breaths per minute

Carbon Dioxide buildup “triggers” breathing

Physiology of Respiration-2

- Factors affecting gas exchange:
  - Composition of inspired gases (%)
  - Volume of inspired gases (Size of inhalation)
  - Partial pressure of inspired gases (Depth x %)
  - Duration of blood exposure to alveolar gases (Duration of inhalation)
  - Activity level:
    - Resting = 0.3 lpm of O_2
    - Working = 3.5 lpm of O_2

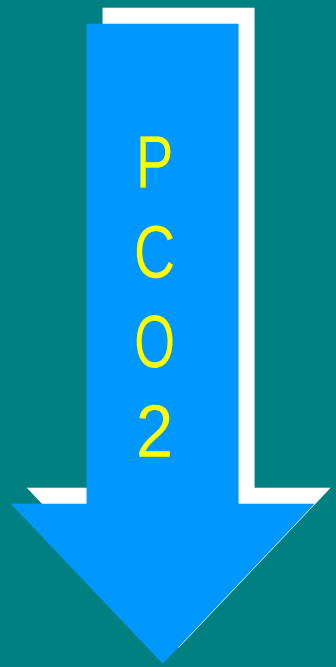
All living tissues need O_2, especially during exercise

Physiology of Respiration-3

- Blood can carry more gases than other solutions
- Hemoglobin (red cells) increases blood's capacity for carrying O_2, CO_2 and CO by about 50 times!
- Partial pressure governs the reaction between O_2 and hemoglobin
- Blood carries O_2 to tissues and CO_2 to lungs
- The central nervous system (2% of body weight) uses 20% of O_2 consumed by the body
- Loss of CNS circulation = unconscious in 15 secs. and brain damage in 3-5 mins.

Hyperventilation

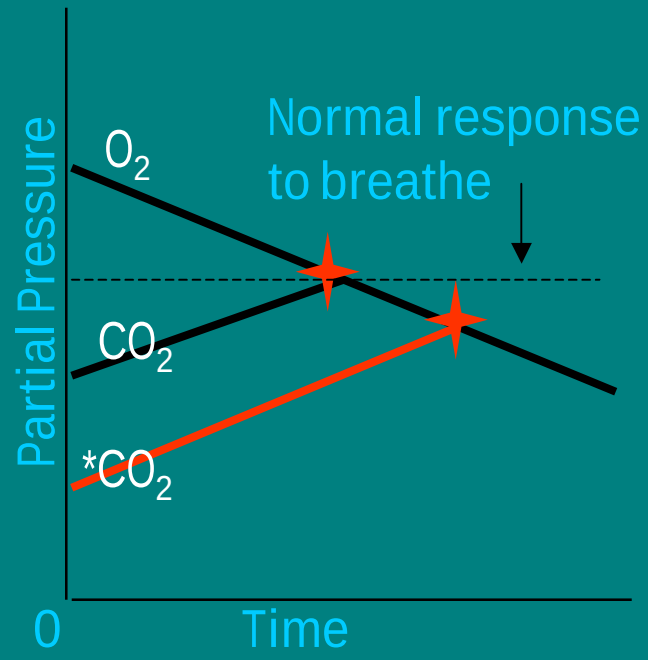
- Cause: breathing in excess of need
  - Voluntary--extends breath-hold time by reducing CO_2
  - Involuntary--caused by anxiety and stress
- Effect:
  - Decreases PCO_2 (Hypocapnia)
  - Barely increases PO_2
  - Increases time before PCO_2 demands breathing
  - Unconsciousness from low PO_2 can occur before PCO_2 reaches threshold



Hyperventilation is dangerous

Shallow-Water Blackout

- Cause: Excessive hyperventilation
- Signs and symptoms:
  - Beginning of breath-hold--lightheadedness, faintness, blurred vision
  - At blackout--Unconsciousness, but no symptoms!
- Treatment: Rescue, life-support
- Prevention: Avoid excessive hyperventilation



After hyperventilation = loss of consciousness

Effects of Smoking

- Short-te cts:
  - CO p
  - Neuro
  - Sens ng disease
  - Heart s
    chang
  - Increa
  - Increa bstain at
    blood hours

Smoking inc op smoking
risks of scuba diving

Near Drowning

- Definition:
  - Suffocation during immersion. (Near drowning if victim recovers)
- Causes:
  - Inspiring large amounts of water quickly
  - Breathing mist for extended time period
- Effect: Hypoxia

- Signs and Symptoms:
  - Coughing
  - Loss of consciousness
  - Pink colored froth from nose and mouth
- First Aid:
  - Rescue
  - Life support
  - 100% oxygen
  - Urgent medical care

Unconsciousness in water leads to drowning

Key Points

- Be in good health for diving
- Refrain from diving when not feeling well
- Abort dive if ill feeling occurs
- Be careful what you breathe
- Breathe properly when diving
- Be prepared for emergencies, which can occur